学 位 論 文 要 旨

Wood properties and anatomical characteristics of three *Eucalyptus* species and their two interspecific hybrids developed in Indonesia

３つのユーカリ属種およびそれらを用いてインドネシアで作出された２つの種間交雑種における木材性質および組織学的特徴

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The interests and development of genetic improvement on *E. urophylla*, *E. grandis*, *E. pellita*, and their interspecific hybrids have increased, especially in Indonesia which faces high disparity between supply and demand of wood resources for industries. These three *Eucalyptus* species and their two interspecific hybrids are expected to meet large demand on wood resources in Indonesia. Although these species and hybrids have been used for producing pulpwood, the available information on wood quality of the *Eucalyptus* species and their hybrids are still limited. Basic knowledge on the wood properties and anatomical characteristics are crucial for determining their potential use and wood quality improvement, especially for producing lumber. Thus, the objectives of the present study are 1) to obtain data on growth characteristics, wood properties, and anatomical characteristics for 9-year-old *E. urophylla*, *E. grandis*, *E. pellita*, and their 4-year-old two interspecific hybrids, *E. grandis* × *E. pellita* (G×P hybrid) and *E. grandis* × *E. urophylla* (G×U hybrid), 2) to investigate the hybridization effects on these two *Eucalyptus* species.

In field experiments, growth characteristics (diameter [D] and tree height [TH]) and stress-wave velocity (SWV) were investigated for the three *Eucalyptus* species and their two interspecific hybrids. A total 245 trees were measured from the three species and six clones of their two hybrids. In addition, respective three selected trees of each *Eucalyptus* species and their two hybrids were harvested, and then discs (3 cm in thickness) and 10 cm length logs obtained at 1.3 m above the ground were used for measuring the wood properties and anatomical characteristics in laboratory experiments.

In three *Eucalyptus* species, significant differences in growth characteristics were observed, whereas the SWV was not. The relationships between growth characteristics and SWV, a non-destructive method for predicting mechanical strength, were positive and significant in all species. Wood shrinkages and mechanical properties, such as compressive strength parallel to grain (CS), modulus of elasticity (MOE), and modulus of

rupture (MOR) were significantly different among the three species. The obtained results suggested that the selection of plus-trees based on the mechanical properties (CS, MOE, and MOR) would significantly improve the mechanical properties of these three species without decreasing the volume yield. In addition, significant differences were observed in vessel element length (VEL), fiber and ray parenchyma proportions (FP and RPP, respectively) among the three species, while it was not observed for derived-wood properties. Although the three species are considered to be good as pulpwood, the *E. grandis* is the best one because of its relatively short VEL, significantly higher and lesser FP and RPP, respectively.

In their two interspecific hybrids, significant differences were observed in growth characteristics and SWV, except for stem diameter in G×P hybrid and SWV in G×U hybrid. Positively low, to significantly medium correlation coefficients were obtained between growth characteristics and SWV in these hybrids. No significant differences were observed between these two hybrids for all measured wood properties. In anatomical characteristics, only cell wall percentage (CWP) was significantly different, while all measured derived-wood properties did not significantly differ. The obtained results on derived-wood properties showed that these two hybrids are considered to be suitable for pulpwood with slightly higher strength properties compared to those in other pulpwood species.

The hybridization effects on growth characteristics were achieved. The hybrids showed over double increasing growth rate compared to that in parent species. The hybridization gave higher CS and produced thinner wall of fibers. In addition, some uniformity values along radial position were observed for BD, wood shrinkage, fiber wall thickness, CWP, and almost all derived-wood properties, except for solid factor. These results indicate the success in hybridization programs on three studied *Eucalyptus* species.

Based on the results in this study, the studied three *Eucalyptus* species and their two interspecific hybrids are considered to be suitable as raw materials for both solid and paper-based products. The obtained positive correlation coefficients between growth characteristics and SWV in three species and their two hybrids indicated that improvement on wood quality, especially mechanical properties, could be achieved without sacrificing the wood yield. Therefore, the selection of plus-trees based on the mechanical properties is the best choice when these three species and two hybrids are prepared for producing higher quality of timber.